



## 1997 Manitoba Hemp Trials Report

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### Executive Summary

In response to the apparent opportunities in commercial cultivation of industrial hemp, Manitoba trials initiated in 1995 and 1996 were continued in 1997. Hemp was grown at five locations under licenses held by Jack Moes of Manitoba Agriculture. Two locations consisted of small-plot replicated variety trials, two of "field-scale" conventional production for grain harvest. Because of environmental conditions, little data was obtained from the small-plot variety trials. Severe hail damage at one site gave an opportunity to observe hemp's ability to recover from such damage, as well as to sample undamaged vs damaged plants for a Health Canada analysis of THC content.

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While yield data by variety was not obtained, enough seed was harvested from each variety to allow for laboratory analysis of oil and meal composition. The data on oil composition suggest that the content of key factors (especially gamma-linolenic acid and antioxidants) tends to be variety dependent more than environment dependent. Economic analyses were revised and continue to indicate a strong potential for hemp from a farm-gate perspective.

### Introduction

Hemp continues to generate significant interest and enthusiasm, with respect to its potential for renewal as a Canadian crop and its diverse potential end uses. Research trials were conducted in Manitoba in 1995, 1996, and 1997 with the following objectives:

1. Evaluate the adaptation of hemp cultivars in various Manitoba agroclimatic regions.
2. Evaluate the end use qualities of Manitoba-grown hemp seed and stalk.
3. Observe for potential pest, disease, or other risk factors.
4. Gain experience in cultivation techniques in anticipation of commercial production.
5. Estimate cost of production and economic viability of hemp as a crop for Manitoba.

### Results of 1997 Trials

## **Field Trials**

### • By site

**Wawanesa** - Small-plot replicated variety trial with 12 varieties. This trial got off to an excellent start, but on the afternoon of July 24/97 was severely damaged by hail. While the extent of the damage was such that meaningful comparative yield data could not be taken, seed samples were obtained at maturity to allow for quality analysis (see Fatty Acid Profiles). Tissue samples were obtained for a special THC analysis by Dr. Bruce Lodge of Health Canada.

**Morden** - Small-plot replicated variety trial with 12 varieties. Trial condition was good throughout the season. However, because of other commitments, the cooperators could not harvest early enough to avoid severe shelling and bird-feeding losses. Consequently no yield data were obtained.

**Lowe Farm** - Organic grain production trial on a heavy clay soil. Germination and initial establishment were fair. However, heavy rains (c. 100 mm in 1 hour) approximately two weeks after emergence left the soil saturated for several days. The saturated soil conditions resulted in severe damage to hemp seedlings. Some recovery was evident, but the damaged stand was not competitive with weeds and a clean-seed yield of only about 20 lbs was obtained from one acre.

**Virden** - Organic grain production trial on a loamy soil. Stand was good but for approximately half of the area, growth was poor and plants attained a height of only 3 - 4 feet. On the other half, growth was healthy and the plants attained an average height of about 6 feet. The difference in performance was attributed to fertility, with the healthy portion being sown where alfalfa was the previous crop. (See Organic Production for further discussion.) Average seed yield was 100 lbs for one acre. The yield from the healthy portion of the field could not be determined precisely, but was estimated to be 200 - 300 lb/acre.

**Fannystelle** - Conventional grain production trial on clay loam. Stand was good and competed well with weeds. Sclerotinia affected approximately 25% of the plants; the source of infection was likely the canola field which surrounded the hemp on three sides. Seed yield was approximately 400 lbs from two acres, and was likely significantly reduced due to the sclerotinia stem rot lesions present. A small amount of the field (approximately 0.5 acre) was cut at mid-flowering with a mower-conditioner to test the feasibility of using such an implement to cut for commercial fibre production. The process was slow, but it could have been speeded up opening or removing the conditioning rolls which were probably not necessary.



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## • THC Content

The results obtained from routine sampling were as follows:

Variety	Location					
	Wawanesa*	Wawanesa**	Morden	Lowe Farm	Virden	Fannystelle
	----- %THC -----					
Beniko	0.12	0.02	0.12	--	--	--
Bialobrezeski	0.07	0.58	0.09	--	--	--
Lovrin 110	0.08	0.15	0.12	--	--	--
Irene	0.59	0.24	0.39	--	--	--
Secuieni	0.42	0.54	0.81	--	--	--
Fedora 19	0.03	0.38	0.09	--	--	--
Felina 34	0.08	0.22	0.05	--	--	--
USO 14	0.01	0.03	0.02	--	--	--
USO 31	0.01	0.01	0.01	--	--	--
Zolotonosha 13	<0.01	0.03	0.01	0.02	0.01/0.01	0.02/0.01
Zolotonosha 15	0.01	0.01	<0.01	--	--	--
Zolotonosha 24	0.01	0.01	0.01	--	--	--

\* sampled by J. Moes; analyzed by Meatherall Consulting  
 \*\* sampled by Souris RCMP (non-standard sampling); analyzed by Health Canada (Winnipeg)

These results suggest that the Romanian varieties Irene and Secuieni are likely to pose a problem in commercial cultivation in Manitoba with respect to THC content exceeding 0.3%. Because of this, and because of late maturity, these cultivars will not be regarded as suitable for cultivation in Manitoba. However, the other varieties consistently fall at or below the defined limit of 0.3% THC. There has been speculation that a severe stress such as hail damage could result in a rebound effect of elevated THC levels. The severe hail damage at the Wawanesa site allowed for sampling of damaged vs undamaged plants from several varieties. These were forwarded to Dr. Bruce Lodge (Health Canada) for analysis. While Dr. Lodge had not yet provided us with a copy of the results at the time of printing, he has indicated verbally that there was no evidence of elevated levels of THC in damaged vs undamaged plant samples.

## ***Analysis of Seed***

### • **Fatty Acid Profiles**

Seed samples from all varieties grown in Manitoba in 1997 were submitted to the University of Manitoba for determination of protein, fat, fibre, fatty acid profile, antioxidants, sterols, and amino acid profile. The fatty acid profile of the seed grown in Manitoba in 1997 vs the original seed imported from the countries of origin was compared to give an indication of varietal vs environmental trends. With gamma-linolenic acid as an example (Figure 1), it seems that genetic differences (ie. Differences among varieties) are much stronger than the environmental differences (ie. Differences within a variety grown at different locations). Total antioxidants in the seed oil responded similarly (Figure 2). Correlation analysis indicated that there was a significant positive relationship between antioxidants and gamma-linolenic acid content (data not shown) - ie. Higher gamma-linolenic and higher anti-oxidants tended to be found in association with each other. This relationship did not exist for other fatty acids and anti-oxidants. Both gamma-linolenic acid and anti-oxidants are important qualities of hempseed oil from a nutritional perspective. These results suggest that varieties shown to produce higher levels of these components in one environment also are likely to produce higher levels in other environments.

### • **Seed Protein/Fibre/Fat**

These components were determined on a dry matter basis, and the balance was calculated and assumed to be composed largely of carbohydrate (Figure 3). These four components are found in roughly equivalent amounts in hempseed. This represents an unusual situation for an oilseed crop - generally dietary fibre is not found in abundance in crops such as soybean or canola. This result affirms the unique nutritive qualities of hempseed. We do not yet have sufficient data of this type to comment on consistent varietal or environmental trends. The amino acid data was not ready when this report was prepared.

### • **Pending Analysis**

Two studies using 1997 material have yet to take place. One will involve decortication and evaluation of fibre quality for potential end-uses. While interest in hemp seed production is significant, it is also recognized that seed processors must address stalk/fibre markets as well, to assist their growers in dealing with the stalk residues remaining after seed is harvested. (One of our cooperators has described hemp stalks as "flax with an attitude". Growers have only two practical choices for stalk disposal: burning or baling. To secure seed supply, seed processors will likely need to work at helping their growers have reason to bale the residual stalk.)

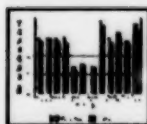


Figure 1 - Click to expand

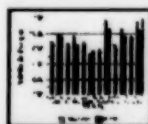


Figure 2 - Click to expand

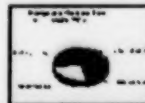


Figure 3 - Click to expand

## **General Comments**

### • **Hail**

A small-plot variety trial in Western Manitoba was severely damaged by hail at the early flowering stage, to the extent that meaningful comparative yield data could not be collected from the trial. Damage occurred primarily in the upper canopy, and took the following forms:

- leaf shredding and stem bruising
- stem and leaf-stalk kinking (ie. sharp bending)
- stem and leaf-stalk breakage and loss of stem tops and leaves.

While the trial was first considered a "dead" loss, within a few days it became evident that recovery was taking place. Kinked stems righted themselves by "goose-necking" from the kinks. Where stem tops and leaves had been severely damaged or lost, axillary branch development took place at nodes below the damaged area. Axillary branches quickly produced inflorescences such that overall development was set back by only a week or so. Seed yields were clearly below potential but not to the extent first predicted.

### • **Excess Moisture**

One organic production trial was located in the Red River Valley on a clay soil with poor internal drainage. Initial establishment was good, but a rainfall of nearly 100 mm two weeks after emergence resulted in saturated soil conditions persisting for several days. Hemp plants turned yellow and ceased development -- the most severely affected died. As the soil drained, some plants resumed growth, but a generally poor, yellowish, stunted and non-thrifty condition persisted through the season. These observations confirm that heavy soils with poor internal drainage represent a high risk situation for hemp production.

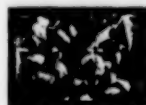
### • **Organic Production**

An organic location in Western Manitoba provided a seed yield of approximately 100 lbs for one acre of production and plant height did not exceed 6 feet. While the yield was somewhat disappointing, the overall experience was encouraging. At least two significant conclusions can be drawn from the experience:

- If the seed drill is not equipped with packing wheels, packing after seeding will likely be necessary to ensure good soil to seed contact in a firm moist seedbed.
- In an organic production situation, adequate fertility may be difficult to attain -- the best results will likely be obtained if hemp follows alfalfa (or another perennial legume) in rotation, or if hemp is sown in a heavily composted field.



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### **Future Research Required**

Industrial hemp regulations will be in place for the 1998 growing season. Several companies across Canada are implementing plans for processing and marketing. Recent news coverage has aroused the interest and enthusiasm of many prospective growers. There has been an implicit assumption underlying much of this that hemp's success is a foregone conclusion -- ie. as of 1998, hemp is a crop that we know how to grow well, and growers and value-added entrepreneurs will immediately see profits from their labours.

It is true that we know we *can* grow hemp in many regions across Canada. However, we are only just beginning to learn to grow it *well*. The research trials in Canada from 1994 to 1997 were our primary education. We have not so much arrived at something, as we have graduated to our next step of education. In that school of commercial hemp cultivation, there are tuition fees yet to pay:

- profits will not be instantaneous for growers and processors;
- growers and industry will need to lobby for government to fund research in support of the ongoing development of the hemp crop and industry -- even more, growers and industry will have to ante up in support of this research, either cash or in-kind, in effect partnering with each other and with government to drive further development.

### **Research Needs**

The following areas of research will undoubtedly be undertaken in due course, as hemp journeys from "new crop" to "established specialty crop". Growers, industry, and government will need to partner together to fund and execute this work.

<b>Research Area</b>	<b>Comments</b>
<b>Varieties</b>	Ongoing evaluation of existing varieties, new variety development with agronomic and quality traits to suit Canadian requirements. New variety development could take place in Canada but may be in cooperation with breeders in Europe. Also, specific requirements for pedigreed seed multiplication need to be learned and adapted to Canada.
<b>Basic agronomics</b>	Some has been done, but further work is necessary to define seeding date, rate, and depth considerations to optimize crop performance in different regions.
<b>Fertility</b>	In conventional agriculture, fertilizer rate and placement studies are required to determine maximum economic yield. In organic agriculture, systems are required to maximize fertility available to a hemp crop.
<b>Weed Management</b>	The risk of loss associated with various weed types and densities needs to be defined. Non-herbicide management strategies need to be developed to ensure that a competitive hemp stand gets the initial advantage over weeds. Herbicides may be deemed necessary, but in-crop use is several years off -- first, screening for suitable products must take place; second, trials in support of minor-use registrations must take place.
<b>Disease Management</b>	The risk of loss under different management and environmental conditions needs to be defined. Cultural practices need to be developed to reduce the risk. Fungicides may be considered in some circumstances, but must go through a program of testing to demonstrate efficiency and safety before they can be registered for legal use in hemp.
<b>Harvest</b>	Harvest timing and techniques to maximize stalk/fibre and/or seed yield and quality must be developed.
<b>Quality</b>	Little is known about management and environmental effects on seed and fibre quality. In the long-run, economic feasibility will require knowledge of such factors. Research is required to conclusively determine thresholds for THC in seed derivatives.
<b>Risk of Losses</b>	To assist growers in making management decisions, and before crop insurance will be readily available for hemp, more information is required regarding risk levels for crop losses associated with poor stands or hail, frost, drought or other factors
<b>New Product Development</b>	Successful establishment of hemp as a specialty crop will require market and new product development. While industry will take the lead here, federal and provincial governments are keen to support such activities.